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PATENT SPECIFICATION

1,098,681

THE PATENT OFFICE
LONDON

DRAWINGS ATTACHED **1,098,681**

Inventor: JULIUS LOUIS GIOVANNUCI

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Int. Cl.:—E 04 b 1/08

COMPLETE SPECIFICATION

Improvements in Light Weight Panel

We, REVERE COPPER AND BRASS INCORPORATED, a corporation organized and existing under the laws of the State of Maryland, United States of America, of 230 Park Avenue, New York, State of New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to light weight high strength structural paneling, and in particular it relates to extruded aluminium panels of the so-called honeycomb panel type and to a system of extendible panels adapted to form larger planar structures.

A well known type of composite structural panel that combines high strength with low weight comprises two substantially parallel outer sheets or skin members separated from each other by a light weight center core that is secured to the inner surfaces of the outer skins. This type of panel is frequently employed as a structural element in aircraft, ships and the like where its inherent properties of high strength and low weight are highly desirable. Such light weight panels are customarily fabricated from sheets of relatively thin gauge metal, the two outer metal sheets or skins being connected by an inner core structure formed from the same material that is brazed or otherwise secured in the inner surfaces of the two skins. The inner core comprises a plurality of sheet metal elements of any convenient configuration disposed substantially perpendicular to the outer skins, one common form of inner core comprising sheet metal elements configured to resemble the hexagonal cells of a honeycomb — from which construction is derived the generic term "honeycomb panel" that is applied to all light weight panel structures of the type described.

The fabrication of a conventional honeycomb panel can be both difficult and expensive. For example, the inner core must first be fabricated and then assembled with the two outer skins to form the composite honeycomb structure, and then the three parts of the composite must be firmly secured or bonded together by a brazing or welding operation or the like. Problems inherent in the complicated fabricating, assembly and bonding operations make it difficult to eliminate minor imperfections in the final product. Moreover, when a number of conventional honeycomb panels are being assembled edge to edge to form a larger structure (such as a wall or a floor), the smooth and efficient joining of abutting edges of the panels presents many problems difficult to solve.

We have now developed a new light weight panel of the so-called honeycomb type that overcomes or eliminates many of the problems and limitations that are inherent in honeycomb panels of conventional construction. In particular, our new honeycomb panel is integrally formed of extruded aluminium so that the difficulties previously encountered in the fabrication, assembly and bonding of the composite panels of the prior art are completely eliminated. Moreover, our new panel is uniquely designed to form a part of an extendible panel system that is adapted to be readily connected to other components to form large planar structures.

Specifically, our new extendible panel system comprises at least one light weight extruded aluminium panel and at least one coupling member connected to the panel along at least one longitudinal edge of the panel, the said extruded panel of the system comprising a first outer skin member, an inner core and a second outer skin member that is spaced apart from and is disposed substantially parallel to said first outer skin member. The inner core comprises a plurality of longitudinally extending web members integrally formed with and extending between the two outer skins, the longitudinal web members being spaced from one another with the longitudinal axes thereof substantially parallel to each other whereby the transverse cross section of the panel has a generally lattice-like configuration. At least one longitudinal edge of the panel is formed with a longitudinal channel that is defined by the edge portions of the two outer skin members and the longitudinal web member adjacent the longitudinal edge portions. The coupling member of the system has at least two planar surfaces disposed parallel to each other and spaced apart a distance such that they are adapted to be inserted between the longitudinal edge portions of the two outer skin members of the panel. In this connection it should be noted that both longitudinal edges of the panel may be formed with longitudinal channels as previously described, or one longitudinal edge may be provided with a pair of longitudinal coupling flange members adapted to be inserted in the longitudinal edge channel of an adjacent panel to which the first panel is being joined.

Our new honeycomb panel construction and the system of which it is a part will be better understood from the following description thereof taken in connection with the accompanying drawing of which:

Figure 1 is a perspective view of two of the new panels of our extendible panel system disposed edge to edge to form a larger structural unit;

Figure 2 is an end elevation of an advantageous embodiment of our new extruded panel showing the lattice-like configuration thereof;

Figures 3, 4 and 5 are fragmentary views of other advantageous forms of our new panel showing the lattice-like configuration thereof;

Figure 6 is a fragmentary sectional view showing an advantageous form of coupling member for joining abutting longitudinal edges of two panels together;

Figures 7, 8, 9 and 10 are sectional views showing other advantageous forms of coupling members for joining the longitudinal edges of two panels;

Figure 11 is a fragmentary perspective view partly broken away showing a channel-shaped end member adapted to cover the exposed upper and lower ends of the extruded panels of our invention;

Figure 12 is a plan view of a door formed from components of our new extendible panel system; and

Figures 13 and 14 are fragmentary sectional views showing top and bottom edge closure members for the door of Figure 12.

The honeycomb panel of our new extendible panel system is integrally extruded in one piece by conventional aluminium extrusion techniques, a typical panel being in the order of 7 feet in length, 1 foot in width and 1 inch in over-all thickness. Two such panels 10 are shown in Figure 1 of the drawing joined together edge to edge to form a larger planar structure in accordance with our system.

As shown best in Figure 2, the light weight extruded aluminium panel 10 comprises a first outer skin member 11, a second outer skin member 12 substantially parallel to and spaced apart from the first outer skin member 11 by a plurality of longitudinally extending web members 13 integrally formed with the two outer skin members in the course of the extrusion of the panel. The longitudinal web members 13 are spaced apart from each other with the longitudinal axis of each web member being disposed substantially parallel to the longitudinal axes of the other web members 13. The two substantially parallel outer skin member 11 and 12 and the plurality of spaced longitudinal web members 13 disposed therebetween together present a unique lattice-like configuration when viewed from one end as clearly shown in Figure 2. The web members 13 shown in Figure 2 have a substantially straight cross-section and are disposed approximately perpendicular to the planar outer skin members 11 and 12. In the embodiments of our light weight panel structure shown in Figures 3, 4 and 5, the web members 13 have an X-shaped cross-section, a semi-circular cross-section and a sinuous or zig-zag cross-section, respectively. In each case, the integrally formed panel of our invention possesses an unusually high strength to weight ratio. The outer skin members 11 and 12 are spaced apart by the web members 13 so that they resist bending forces in a lateral direction, and the laterally spaced longitudinal web members 13 are disposed between the two skin members so that they resist bending forces that would deform the panel longitudinally.

At least one longitudinal edge, and advantageously both longitudinal edges, of the panel 10 is formed with a longitudinal channel 15 defined by the adjacent edge portions of the two outer skin members 11 and 12 and the web member 13 adjacent that longitudinal edge. The longitudinal channels 15 formed along the longitudinal edges of the panels of our invention facilitate smooth and efficient edge to edge connecting of two adjoining panels. To effect the edge to edge juncture of two adjoining panels, a coupling member 16 advantageously formed of extruded aluminium tubing is inserted into the longitudinal channels 15 of the adjoining panels as clearly shown in Figure 6. The coupling member 16 is formed with at least two flat or planar surfaces 17 that are disposed substantially parallel to each other and are spaced apart a distance such that these surfaces of the coupling member are adapted to be inserted between the inner surfaces of the adjoining longitudinal channels 15 of the two adjacent panels 10. The juncture effected between the coupling member 16 and the adjoining edges of the two panels may be of a temporary nature in which case the tubular coupling member 16 is held in the longitudinal channels 15 mainly by frictional forces, or the juncture can be made permanent by welding, riveting, adhesively bonding or otherwise permanently securing the coupling member 16 in place in the longitudinal channels 15 of the two adjoining panels.

In an advantageous modification of our extruded panel, one longitudinal edge of the panel 10 is formed with a longitudinal channel 15 as previously described and the other longitudinal edge of the panel is integrally formed with a coupling member comprising a pair of longitudinal coupling members or flanges 18 as clearly shown in Figure 7. The integrally formed flange-type coupling members 18 disposed along one of the longitudinal edges of one panel 10 are formed with substantially planar surfaces 17 disposed parallel to each other and spaced apart a distance such that they are adapted to be inserted into the longitudinal channel 15 of an adjoining panel 10. As previously mentioned, if a temporary joint that is all that is required, the two panels 10 may be held together by the frictional forces existing between the inner surfaces of the channel member 15 and the contacting outer surfaces 17 of the coupling member 18. When a permanent joint between the two panels is desired, the longitudinal coupling members 18 can be welded or bolted or adhesively bonded or otherwise permanently secured to the inner surfaces of the longitudinal channel 15 into which they are inserted.

The tubular coupling member 16 shown in Figure 6 and the integrally formed flange-type coupling member 18 shown in Figure 7 are particularly useful when two or more panels are to be connected together to form a larger planar structure all of the panels of which are in the same plane. When it is desired to connect two panels together at a right angle, as for example at the corner of a room, a special right angle coupling member 19 shown in Figure 8 may be employed. The coupling member 19 is provided with two pairs of coupling flanges 18 similar to the integrally formed coupling flanges shown in Figure 7, the pair of flanges 18 at each end of the coupling member 19 being adapted to be inserted in the channels 15 formed along the longitudinal edge of one of the panels 10. The panels of our invention may also be joined together edge to edge at angles other than 90° by means of specially designed angular coupling members such as the flange-type coupling member 20 shown in Figure 9 of the drawing. Moreover, the coupling member may be a hollow aluminium extrusion such as the curved coupling member 21 shown in Figure 10. The coupling member 21 resembles to a certain extent one of the panels 10, both longitudinal edges of the coupling member, however, being provided with pairs of integrally formed coupling flanges 18 adapted to be inserted into the longitudinal channel 15 of a panel 10.

The combination of one of the coupling members, for example the coupling member 16, with one of the panels 10 of our invention comprises an extendible panel system that may be combined or assembled with other components, for example with other panels, to form large planar structures of any desired size, the thus assembled structures conveniently forming the floors, walls and ceilings of compartments and other enclosures on board ships and aircraft as well as in buildings erected on land. The panels 10 are, of course, formed with tubular passageways extending longitudinally the length of each panel, and these tubular passageways may provide convenient ducts for electrical wiring and other equipment. When it is desired to close off the ends of the panels, a channel-shaped end closure member 23 of the type shown clearly in Figure 11 may be applied thereto.

As previously indicated, the panel and coupling member components of our extendible panel system may be assembled with other specially designed components to form a variety of such specialized planar structures as doors, sliding panels, wall cabinets and the like. For example, the door shown in Figure 12 comprises three extruded aluminium honeycomb panels 25, 26 and 27 joined together edge to edge by the coupling members 28 in accordance with our invention, the top and bottom edges of the three panels being covered or closed by the cap members 29 and 30 as shown in Figures 13 and 14 of the drawing. The centermost panel 26 is integrally formed with longitudinal channels 15 extending along both longitudinal edges of the panel, while the two outer panels 25 and 27 are each formed with only one longitudinal channel 15, the other longitudinal edge of each panel 25 and 27 being integrally formed with closed outer edges as shown in the drawing. The coupling members 28 are formed of extruded aluminium tubing similar to the tubular coupling member 16 shown in Figure 6, and the end caps 29 and 30 are also advantageously formed of aluminium extrusions.

The planar structures, for example, doors, walls and the like, assembled from the components of our extendible panel system may be left with a natural aluminium finish, or, if desired, one or both surfaces of the planar structure may be covered or coated with any desired finish material. For example, the aluminium surface may be covered with a thin layer of copper or stainless steel sheet mechanically or adhesively bonded thereto, and in a particularly advantageous embodiment the surface of the aluminium is covered with a layer of decorative plastic material, adhesively secured thereto.

From the foregoing description of our extruded aluminium panel it will be seen that we have made an important contribution to the art to which our invention relates.

WHAT WE CLAIM IS:—

1. An extendible panel system capable of being assembled with other components to form large planar structures which comprises at least one light weight extruded aluminium panel and at least one separable coupling member connected to said panel along at least one longitudinal edge of said panel, said extruded aluminium panel comprising a first outer skin member, a second outer skin member spaced apart from and disposed substantially parallel to said first outer skin member, and a plurality of longitudinally extending web members integrally formed with and extending between the two outer skin members, the longitudinal web members being spaced apart from each other with the longitudinal axes thereof disposed substantially parallel to each other whereby the transverse cross section of the panel has a substantially lattice-like configuration, at least one edge of the panel being formed with a longitudinal channel defined by the edge portion of the two outer skin members and the longitudinal web member adjacent said longitudinal edge portions, said separable coupling member having at least two planar surfaces disposed parallel to each other and spaced apart a distance such that they are adapted to be inserted between the inner surfaces of the longitudinal channel defined by the edge portions of the two outer skin members of the panel.

2. The extendible panel system according to claim 1 in which both longitudinal edges of the light weight panel are formed with a longitudinal channel each of which is defined by the associated edge portions of the two outer skin members and the longitudinal web member adjacent said longitudinal edge portion.

3. The extendible panel system according to claim 1 in which one longitudinal edge of the light weight panel is formed with said longitudinal channel and the other longitudinal edge is formed with a pair of longitudinal coupling flanges extending laterally beyond and parallel to the outer skin members, said flange members having outer surfaces spaced apart a distance such that they are adapted to be inserted into the longitudinal channel formed along one longitudinal edge of another light weight panel of the system.

4. The extendible panel system according to claim 1 in which the coupling member comprises a tube having at least two planar surfaces disposed parallel to each other and spaced apart a distance such that they are adapted to be inserted into the longitudinal channels formed along the adjoining edges of a pair of lightweight panels of the system being joined together.

5. The extendible panel system according to claim 1 in which the coupling member comprises an extruded aluminium shape having at least two pairs of longitudinal coupling flanges projecting from opposite edges thereof, each pair of coupling flanges having planar outer surfaces disposed parallel to each other and spaced apart a distance such that they are adapted to be inserted into the longitudinal channel formed along one edge of a light weight panel of the system.

6. The extendible panel system according to claim 1 in which the web members of the light weight panel have a substantially straight cross-section and are disposed substantially perpendicular to the skin members of the panel.

7. The extendible panel system according to claim 1 in which each web member of the light weight panel has an X-shaped cross-section.

8. The extendible panel system according to claim 1 in which each web member of the light weight panel has a substantially semi-circular cross-section.

9. The extendible panel system according to claim 1 in which each web member of the light weight panel has a substantially sinuous cross-section.

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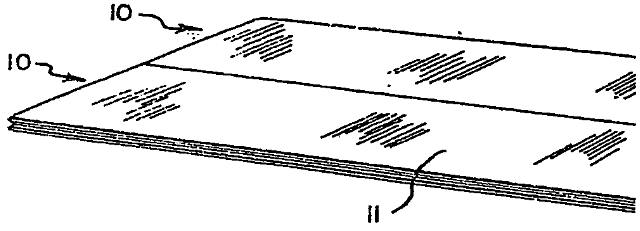


FIG. 2

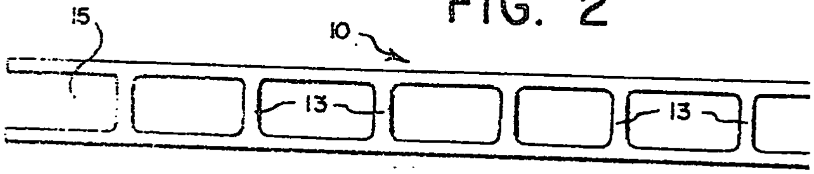
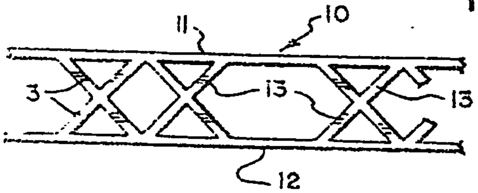
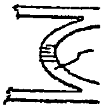
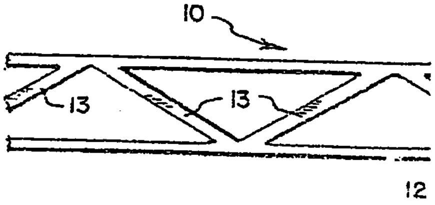


FIG. 3







1298681 COMPLETE SPECIFICATION

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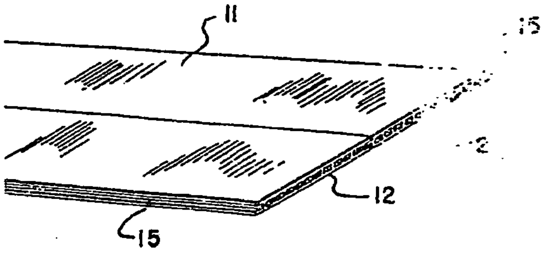
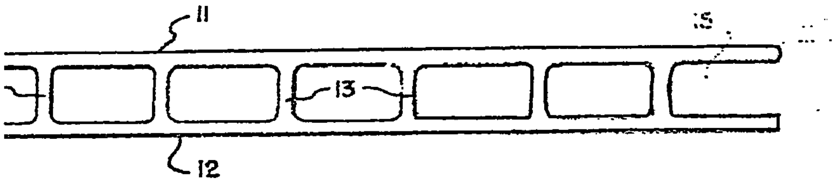
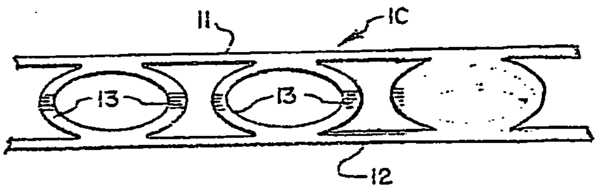


FIG. 1





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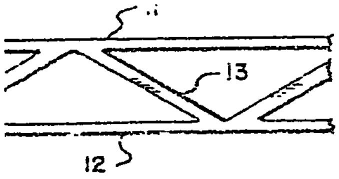

POOR QUALITY

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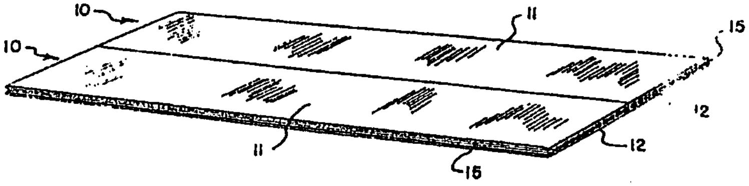


FIG. 1

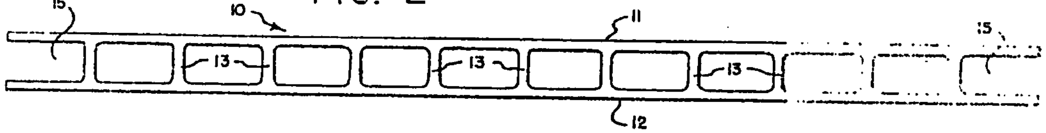


FIG. 2

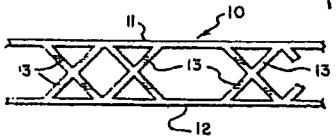
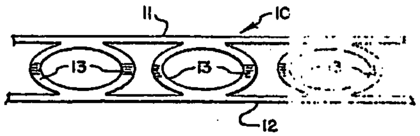


FIG. 3



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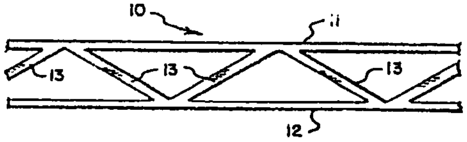

FIG. 5

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FIG. 6

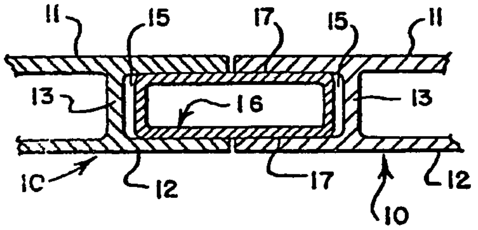


FIG. 8

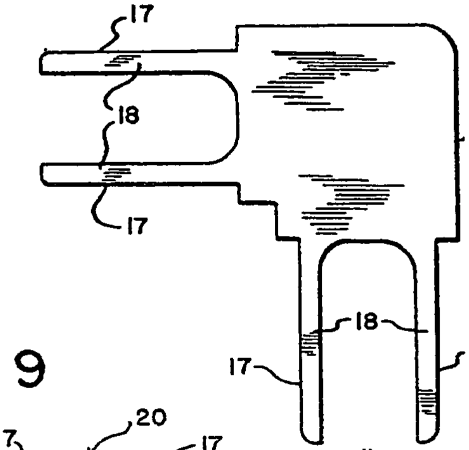
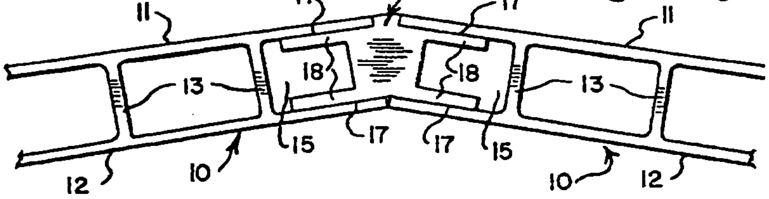


FIG. 9



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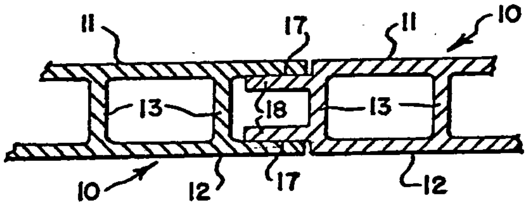
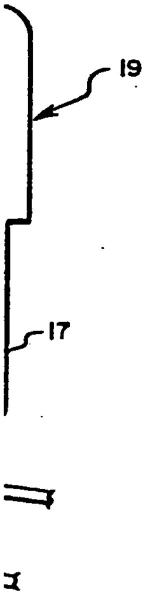


FIG. 7



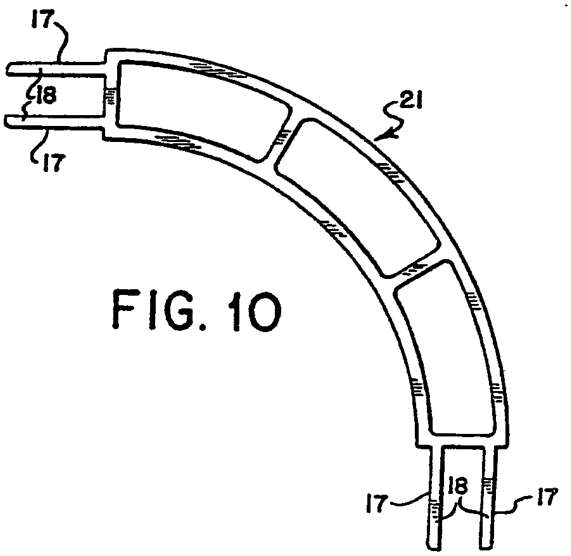


FIG. 10

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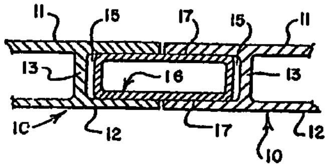


FIG. 6

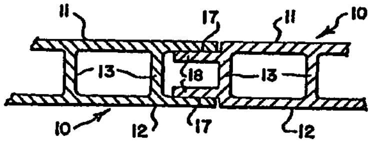


FIG. 7

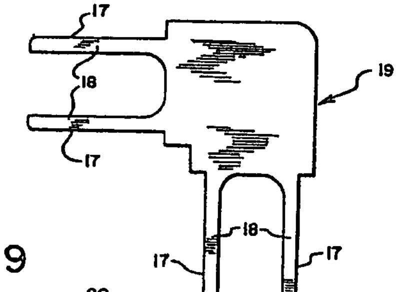


FIG. 8

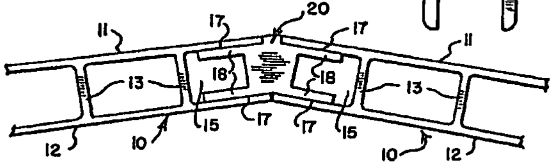


FIG. 9

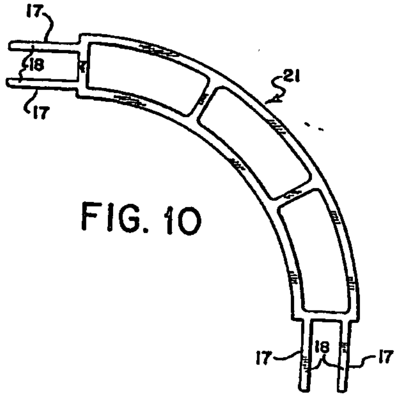


FIG. 10

FIG.

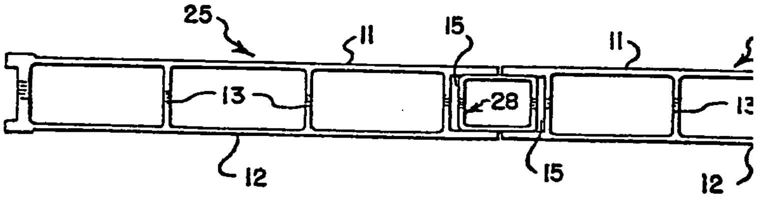
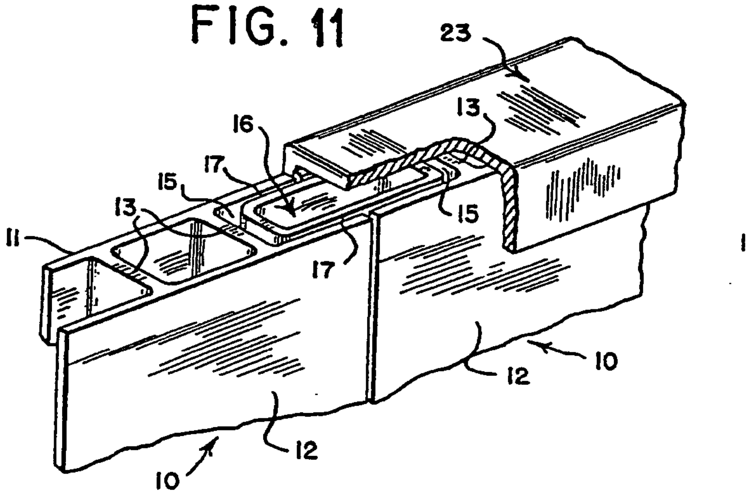


FIG. 11



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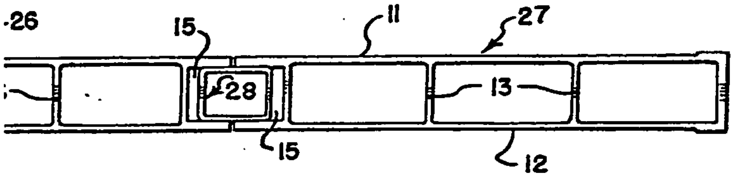

FIG. 13

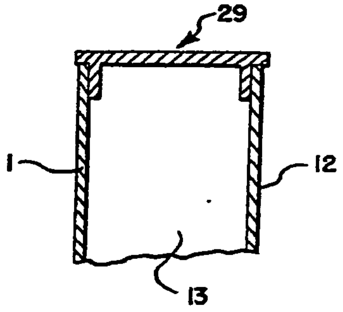

FIG. 14

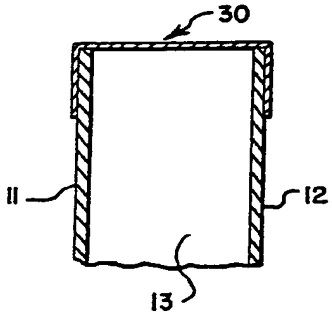

FIG. 12

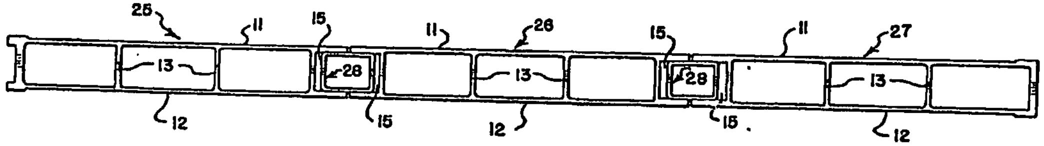

FIG. 11

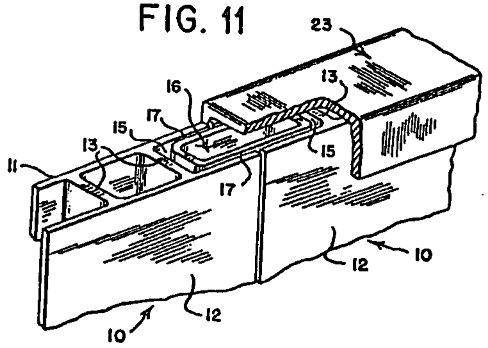

FIG. 13

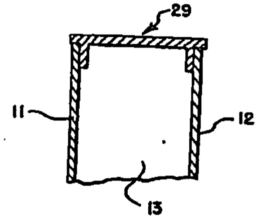

FIG. 14